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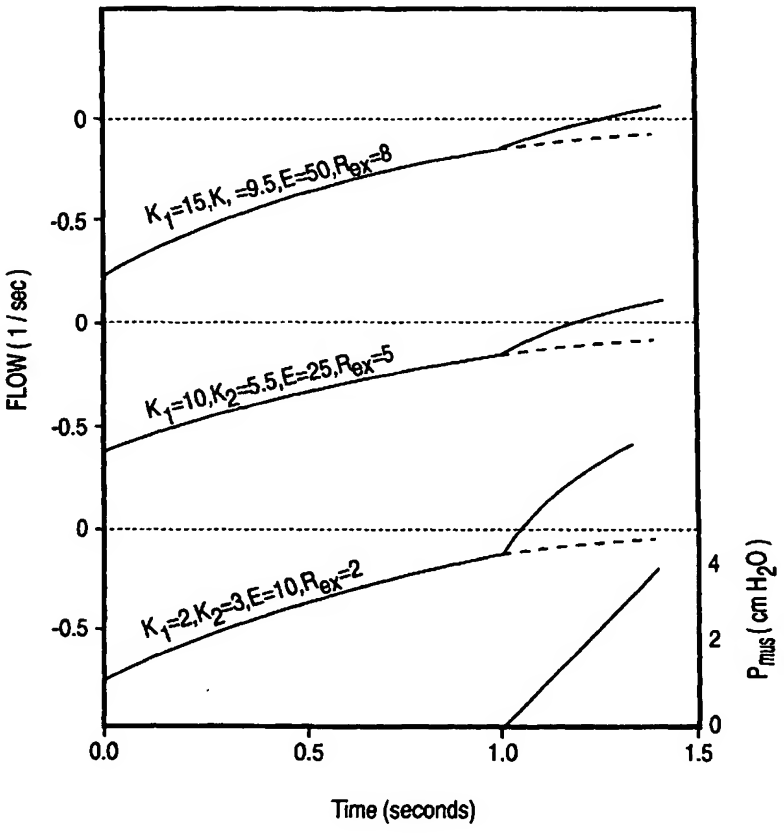
[Continued on next page]

(54) Title: METHOD AND DEVICE FOR MONITORING AND IMPROVING PATIENT-VENTILATOR INTERACTION



(57) Abstract: Method and apparatus for non-invasively determining the time onset (T_{onset}) and end (T_{end}) of patient inspiratory efforts. A composite pressure signal is generated comprising the sum of an airway pressure signal, a gas flow pressure signal obtained by applying a gain factor (K_f) to a signal representing gas flow rate and a gas volume pressure signal obtained by applying a gain factor (K_v) to a signal representing volume of gas flow. K_f and Kv values are adjusted to result in a desired linear trajectory of composite pressure signal baseline in the latter part of the exhalation phase. The current composite pressure signal is compared with (i) selected earlier composite pressure signal values and/or (ii) value expected at current time based on extrapolation of composite pressure signal trajectory at specified earlier times and/or (iii) the current rate of change in the composite pressure signal with a selected earlier rates of change. The differences obtained by the comparison are compared with selected threshold values. T_{onset} is identified when at least one of the differences exceeds the threshold values.

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SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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— *with international search report*

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(88) Date of publication of the international search report:
8 April 2004

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INTERNATIONAL SEARCH REPORT

Inter[illegible]nal Application No
PCT/CA[illegible]/00976

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61M16/00 A61B5/087

PTO 10 DEC 2004

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61M A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00/45881 A (UNIV FLORIDA) 10 August 2000 (2000-08-10) page 17, line 12 - page 18, line 9	1,15,24
A	US 5 660 171 A (FENNEMA PAUL J ET AL) 26 August 1997 (1997-08-26) column 3, line 52 - column 4, line 8	1
A	US 5 582 163 A (BONASSA JORGE) 10 December 1996 (1996-12-10) column 3, lines 16-29; claim 1	1
P,A	US 6 439 229 B1 (AMATO MARCELO B P ET AL) 27 August 2002 (2002-08-27) summary of invention	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 October 2003	-5. 02. 2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Papone, F

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/CA 03/00976

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-18,22-37,44-46

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-18,22,23,24-37,44-46

   a method and a device to detect and operate a ventilator by the use of the linear combination of parameters related to inflowing flow, pressure and volume, and drawing a prediction curve

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2. claims: 19-20,21,38-41

   a method and a device to operate a ventilator by averaging inspiration times and the timing of other time related parameters in the respiration cycle

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3. claim:

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4. claims: 42-43

   a device determining a desirable duration of the inflation phase and measuring flow at the end of such desirable duration.

INTERNATIONAL SEARCH REPORT

[redacted]on patent family members

International Application No
PCT/CA 03/00976

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